ESO 1268

COSTS OF PRODUCING DECIDUOUS SHRUBS (VIBURNUM) IN THE FIELD DIFFERENTIATED BY SIZE OF FIRM IN OHIO

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April 22, 1986

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ABSTRACT

The objective of this study was to determine annual production costs for field-grown deciduous shrubs in Ohio differentiated by size of firm. This objective was accomplished by synthesizing two model field nurseries using the conceptual framework of economic engineering. Once the nurseries were synthesized, growing space was divided into five equal parts with each part being assigned a plant group. In the 50-acre nursery, shade trees were allocated 8 acres of growing space and in the 200-acre nursery 35 acres. One specific species of deciduous shrub (Viburnum) was chosen for detailed analysis.

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In addition to research, Drs. Taylor, Smith, and Hahn have appointments in the Ohio Cooperative Extension Service.

In the space allocated, 6,208 3-4 foot tall salable Viburnum could be produced annually in the 50-acre nursery and 27,162 in the 200-acre. Total costs per salable plant were $12.00 in the 50-acre nursery and $7.07 in the 200-acre. These costs were based on 1985 figures.

INTRODUCTION

Deciduous shrubs including various species of Viburnum, Forsythia, Weigela, and Ligustrum have always been very important in the Ohio landscape. As a group they encompass a wide range of growing habits, size, foliage, flower, and fruit colors and they can be effectively used in many ways in the landscape. Most deciduous shrubs being grown in Ohio are quite hardy and require only minimum overwinter protection even when being grown in containers.

The specific objective of this study was to determine annual production costs for deciduous shrubs grown in the field differentiated by size of firm. This information should aid Ohio nurserymen in their decisions regarding which plants to grow and in what quantities.

MATERIALS AND METHODS

In the study, two model firms were synthesized using the conceptual framework of economic engineering wherein the 'best proven practice' was included in each model. They were

synthesized based on the Columbus, Ohio, area. The complete synthesis included developing an appropriate production cycle; schematic drawings of the physical layout, including buildings and irrigation systems; lists of equipment and other items; a complete sequence by month and year of nursery operational steps beginning with propagation and ending with loading the finished product for wholesale distribution; and budgets for fixed and variable costs.

Data for this study were obtained from wholesale nurseries and nursery suppliers in Ohio during 1985. The basic goals in synthesizing the production facilities were to minimize labor expenses, flow and movement of plant material and equipment, water runoff, and initial investment, and to maximize the number of salable plants and keep future expansion possible. See Taylor et al. (1) for a detailed analysis of the physical plant, production system, and capital production budgets. The first step in the production cycle consisted of collecting cuttings from field plants that are at least two years old. Cuttings were trimed and treated with a hormone solution and stuck in a heated sand bed in an "overwintering" house. During march of the second production year the 9 month old rooted cuttings are pulled from the propagation beds, root pruned by hand, and planted into four feet wide beds. The rooted cuttings are spaced 20" apart between rows and 7" within rows. After one year in the beds, they are dug, root and top pruned by hand, and planted in the field. Approximately 25% of the crop will be harvested and sold during

the fall of the third field production year and another 25% dug, overwintered, and sold during late Winter and early Spring of the fourth field production year. The remaining 50% of the crop will be harvested and sold during later Winter and Spring of the fourth field production year. After the harvest is complete, the land is left fallow and disked for weed control four times during summer months. The fields are plowed in the fall of the fourth field production year in preparation for spring planting.

A model facility was synthesized for both a 50-acre and a 200-acre field nursery. The nursery operations were assumed to produce a diverse line of nursery stock each having its own unique production cycle. Commonly grown nursery stock was divided into five cultural groups. While not all inclusive, the groups do permit developing a range of per unit costs related to input costs and cultural factors. For analytical purposes, it was assumed that each cultural group would occupy 20% of the field growing area (i.e. 50-acre nursery = 8 acres per group, 200-acre nursery = 35 acres per group. In addition to the field growing area, the 50-acre nursery had 10 acres and the 200-acre nursery 25 acres of production facilities including overwintering houses, propagation facilities, shipping area, holding area, liner bed area, pond, supply shed, machinery storage, machine shop, office, and rest rooms. Costs developed on deciduous shrubs Viburnum) herefore were based on the scale of complete nurseries, but were analyzed on the basis of percent of total space occupied. Companion studies in this publication report on

fixed costs (page), slow growing evergreens (page), and shade trees (page).

For detailed analysis on deciduous shrubs, one specific plant type (Viburnum) was chosen, While it is recognized that other deciduous shrubs (i.e. Forsythia) would have somewhat different requirements, it was felt that the requirements would not vary significantly in cost from the Viburnum analyzed.

Costs were established for all factors of production including management and invested capital. In economic terms, costs associated with factors of production inputted by owner/operators are often referred to as 'opportunity costs' or the income these factors could have received if they were employed elsewhere. For example, owners could usually be employed as managers at other nurseries, and money invested in land, buildings, irrigation systems, and equipment could have earned interest if it had been placed in financial institutions.

Capital requirements for establishing the nurseries were first determined (1). Second, capital requirements per salable plant capacity by size of nursery were established (1). Third annual fixed costs were calculated (see page). Fourth, annual variable costs were determined for each of the two sized nurseries (Tables 1 and 2). Fifth, summaries were made for fixed and variable costs according to size of nursery (Table 3). This allowed cost comparisons based on size of nursery.

Most nurseries use cash rather than accrual accounting procedures. For this reason, the analyses were completed on a "cash" basis. Analysis on a cash basis does not give a true economic picture of the cost of producing a plant as it does not take into account the time value of money from the time the plant is planted until it is harvested. The analyses do, however, give a true estimate of the annual cost per salable plant based upon the study's assumptions.

Total annual production costs consist of both fixed and variable factors. Fixed costs are primarily made up of implicit costs such as depreciation on buildings and equipment, interest charges (both for borrowed and equity capital), and charges for management. Many nurserymen do not adequately consider fixed costs when computing costs of production. Fixed items are often considered as residual claimants on income. For example, management is compensated if all other factors of production have been accounted for. As noted previously, annual fixed costs are discussed in greater detail in a companion article.

Variable costs include all cost factors that vary with the quantity of plants being grown at one point in time. Variable costs are explicit, obvious, and normally paid out yearly. An example of variable costs is the amount of burlap that would be needed yearly for harvesting (Viburnum) in a ball & burlap operation. Variable costs were subdivided into the following categories: propagation, materials, machinery and equipment, labor, and interest on operating capital (Tables 1 and 2).

Details on specific variable costs, other than liners, are included in the companion article on slow growing evergreens (page).

RESULTS AND DISCUSSION

Annual fixed, variable, and total production costs of producing deciduous shrubs (Viburnum) in the field in Ohio for 1985 are summarized in Table 3. In the 50-acre nursery, total annual costs were $74,546 or $12 per salable 3-4 foot tall plant. Fixed costs totaled $46,902 or $7.56 per plant and made up 63% of total costs. Based on percentage of total costs, land and improvements made up 9%, buildings 6%, machinery and equipment 18%, general overhead 28%, and interest on general overhead, insurance, and taxes 2%. Variable costs totaled $27,644 or $4.44 per plant and made up 37% of total costs. Based on percentage of total costs, propagation made up 3%, materials 6%, machinery and equipment 8%, labor 18%, and interest on operating capital 2%.

In the 200-acre nursery, total annual costs were $192,167 or $7.07 per salable 3-4 foot tall plant. Fixed costs totaled $88,905 or $3.27 per plant and made up 46% of total costs. Based on percentage of total costs, land and improvements made up 11%, buildings 4%, machinery and equipment 13%, general overhead 17%, and interest on general overhead, insurance, and taxes 1%. Variable costs totaled $103,262 or $3.80 per plant and made up 54% of total costs. Based on percentage of total costs, propagation made up 1%, materials 11%, machinery and equipment

8%, labor 31%, and interest on operating capital 3%.

Total annual costs were $4.93 per plant more in the 50-acre nursery than in the 200-acre. Of this $4.93, $4.29 or 87% were made up of fixed costs. On a per item basis, the 200-acre nursery's advantages were 34 cents on land and improvements, 51 cents on buildings, $1.18 on machinery and equipment, $2.12 on general overhead, and 14 cents on interest for general overhead, insurance, and taxes. The 64 cent difference for variable costs was 16 cents for propagation, 1 cent for materials, 44 cents for machinery and equipment, 2 cents for labor, and 3 cents for interest on operating capital.

In the nurseries analyzed, it cost 41% less to produce a 3-4 foot tall deciduous shrub (Viburnum) in the 200-acre nursery than in the 50-acre. While the overall reduction was 41%, it was 57% for fixed costs and only 16% for variable. Large-sized commercial field nurseries are able to make more efficient use of buildings, equipment, machinery, labor, and general overhead than is the case for small field nurseries.

One note of caution should be observed in comparing costs between the two sized nurseries. Each of the nurseries were analyzed based on the assumption that they would produce a diverse line of plants which included both shrubs and trees. This assumption might be unrealistic for the 50-acre nursery as a considerable amount of specialized equipment was required. It should also be noted that many operators of smaller nurseries might choose a different line of equipment than that budgeted.

While the equipment budgeted is capable and labor saving, smaller nurserymen might have a surplus of family labor and choose less expensive, less labor saving equipment. Also, a small nursery might well operate its office, etc. out of the home.

Individual nurserymen might well experience or at least calculate costs considerably different than those depicted here. Most cost differences would probably be reflected in fixed rather than variable costs. Most fixed costs are implicit and their full impact may not be calculated by established nurserymen. Budgets presented assumed new facilities, machinery, and equipment. Most nurserymen have owned their land for many years and have used machinery and equipment. For the established nursery, budgeted fixed costs on land improvements, buildings, machinery, and equipment presented here would reflect replacement rather than 'book' value of depreciated items. Presented fixed costs also placed a market value on management. Many nurserymen place little if any value on their own management when computing costs. Variable items, on the other hand, are explicit, experienced at least yearly, and easily accounted for. Variable costs presented here would be typical for the industry in Ohio and should be rather consistent regardless of age and size of the nursery.

SUMMARY

Total annual costs per 3-4 foot tall salable deciduous shrub (Viburnum) were $12 in the 50-acre field nursery and $7.07 in the 200-acre field nursery. Fixed costs were $7.56 in the 50-acre nursery and $3.27 in the 200-acre for a differential of $4.29 per salable plant. Variable costs, on the other hand, were $4.44 in the 50-acre and $3.80 in the 200-acre for a differential of $0.64. These plant costs assumed propagation in the nursery (9 months), liner production in beds (2 years), and field growing (3 years), ball and burlapped harvesting, and an average height of 3-4 foot per salable plant.

These figures demonstrated that variable costs on a salable plant basis, at least over the size range of nurseries analyzed, had a moderate reduction of about 14% when going from a 50-acre nursery to a 200-acre. This reduction was primarily accounted by efficiencies gained in propagation, and machinery and equipment. Fixed costs, on the other hand, had a substantial reduction of about 57% as size of nursery was increased. This occurred because most of the fixed factors required to operate the 50-acre nursery such as management, buildings, and most machinery and equipment were also adequate to operate the 200-acre. As the size of nursery increased, costs for fixed items of production were spread over more salable units, thereby reducing the fixed cost per plant.

LITERATURE CITED

1. Taylor, Reed D., Harold H. Kneen, Elton M. Smith, David E. Hahn, and Stanley Uchida. 1985. Costs of Establishing and Operating Field Nurseries Differentiated by Size of Firm and Species of Plant in U.S.D.A. Plant Hardiness Zones Five and Six. Southern Coop. Ser. Bull. 315.

TABLE 1.--Variable Costs (Dollars) for Deciduous Shrubs (Viburnum) for a 50 Acre* Field Nursery in Ohio, 1985.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Propagation***					
Rooting media	Sand	cubic yd.	6.50	12.00	78
Collecting, stripping & sticking	11,869 @ 1000/hr.	hrs.	6.93	11.87	82
Maintainance	25% of total prop. maint, hrs.	hrs.	6.93	182.50	1,265
Harvest	11,869 @ 400/hr.	hrs.	6.93	29.68	206
Hormone powder	#1, I.B.A.	lbs.	8.00	0.34	3
Subtotal					1,634
Materials					
Burlap	32" x32" squares + twine	each	0.45	6,208.00	2,794
Polyethylene film	4 mil white, 32' x 225'	each	127.50	1.55	198
Strip tags	5/8" X 7" plastic strip tag	each	0.02	6,208.00	124
Chemicals	Custom spread, custom blend: 45-0-0, 0-44-0, 0-0-60 (fertilizer)	ton	176.00	1.25	220
	Custom spread, (lime)	ton	20.00	1.21	24
	Urea, 45-0-0 (fertilizer)	ton	220.00	0.66	145
	Soluble 20-20-20 (fertilizer)	ton	1,411.20	0.06	85
	Trifluralin 4 EC (Treflan) (herbicide)	gallon	33.49	0.55	18
	Simazine 80WP (Princep) (herbicide)	pound	3.75	15.53	58
	DCPA 75WP (Dacthal) (herbicide)	pound	6.37	43.47	277
	Malathion, 57EL, (Cythion) (insecticide)	gallon	18.28	13.97	255
	Benomyl, 50 WP, (Benlate) (fungicide)	pound	14.17	9.32	132
	Carbaryl, 80WP (Sevin) (insecticide)	pound	6.09	23.29	142
	Chlorothalonil 10M cu. ft.(Termil) (fung.)	canister	1.76	4.65	8
	Other (i.e. Kelthane, Captan, Di-syston, Orthene, etc.)*****				265
Subtotal					4,745
Machinery and Equipment					
	Tractor, 100 HP	hour	17.00	35.58	605
	Tractor, 34 HP	hour	4.99	34.44	172
	Articulated Loader/3,000lbs	hour	14.81	57.78	856
	Fork	hour	0.01	57.78	1
	Plow, 3-14"	hour	6.57	1.77	12
	Disk, 8' wide	hour	4.23	3.58	15
	Harrow, 10' wide	hour	8.45	0.27	2
	Cultimulcher, 10' wide	hour	24.70	0.54	13
	Spray rig with 10' boom	hour	2.77	2.57	7
	Transplanter, 3 row	hour	26.79	1.83	49
	Permanent irrigation\ well & pump 100HP	hour	7.60	40.00	304
	Inground irrigation - bed area	hour	3.13	24.00	75
	Above ground irrigation - bed area	hour	1.83	24.00	44
	Inground irrigation - storage & holding	hour	5.65	12.00	68
	Above ground irrigation - storage & hold.	hour	11.05	12.00	133
	Traveler gun	hour	12.06	4.00	48

Table 1 Cont.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
	Portable PTO pump, 40 HP	hour		(no costs budgeted)	
	Airblast sprayer	hour	1.01	18.63	19
	Fertilizer injector	hour	12.39	1.50	19
	Transplanter, 2 row	hour	12.00	3.04	36
	Undercutter, bed	hour	1.61	1.76	3
	Sidedresser, 2 row	hour	0.63	3.60	2
	Cultivator, 2 row	hour	0.95	11.88	11
	Wagon, 4 wheel	hour	0.48	16.16	8
	Cultivator, 3 row	hour	13.93	0.69	10
	Truck, 1/2 ton pickup	hour	8.42	346.71	2,919
	Flatbed truck, 24' bed	hour	14.87	35.92	534
Subtotal					5,965
Labor					
	Labor hours	hour	6.93****	1,651.59	11,446
	Related labor hours, 20%	hour	6.93	330.32	2,289
Subtotal					13,735
Interest Charge on Operating Capital	Computed at 12% on an annual basis for 6 months	percent	6.0 (0.06)	26,079.00	1,565
Total Variable Costs					27,644
Variable Cost per 3-4' Tall Salable Plant	Units available for sale in a given year	each		6,208.00	4.45

*Total Nursery - 50 acres, 40 acres of growing space, 10 acres production facilities, holding & field bed area, roads, etc. Deciduous Shrubs - 10 acres, 8 acres of growing space, 2 acres production facilities, holding & field bed area, roads, etc., 6,208, 18-24 inch salable plants per year.

**Quantity discounts were applied to chemicals and other items.

***11,869 plants would be stuck in the propagation house where about 23% would be lost leaving 9,130 for transplanting into liner beds. About 20% of the plants in the liner beds would be lost leaving 7,304 for transplanting into the field.

****Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.

*****To achieve better pest and disease control, alternative chemical useage is advisable. Alternative chemical costs were estimated at 50% of the cost of Malathion, Benomyl, and Carbaryl.

TABLE 2.--Variable Costs (Dollars) for Deciduous Shrubs (Viburnum) for a 200 Acre* Field Nursery in Ohio, 1985.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
Propagation***					
Rooting media	Sand	cubic yd.	6.50	24	156
Collecting, stripping & sticking	51,927 @ 1000/hr	hrs.	6.93	51.93	360
Maintainance	25% of total prop. maint. hrs.	hrs.	6.93	200.00	1,386
Harvest	51,927 @ 400/hr.	hrs.	6.93	129.93	900
Hormone powder	#1, I.B.A.	lbs.	8.00	1.49	12
Subtotal					2,814
Materials					
Burlap	32" x 32" + squares + twine	each	0.45	27,162.00	12,223
Polyethylene film	4 mil white, 32' x 225'	each	127.50	6.79	866
Strip tags	5/8" X 7" plastic strip tag	each	0.02	27,162.00	543
Chemicals	Custom spread, custom blend: 45-0-0, 0-44-0, 0-0-60 (fertilizer)	ton	176.00	5.46	961
	Custom spread, (lime)	ton	20.00	9.67	193
	Urea, 45-0-0 (fertilizer)	ton	220.00	2.89	636
	Soluble 20-20-20 (fertilizer)	ton	1,411.20	0.28	395
	Trifluralin 4 EC (Treflan) (herbicide)	gallon	33.49	2.42	81
	Simazine 80WP (Princep) (herbicide)	pound	3.75	67.93	255
	DCPA 75WP (Dacthal) (herbicide)	pound	6.37	190.19	1,212
	Malathion, 57EL, (Cythion) (insecticide)	gallon	18.28	61.13	1,117
	Benomyl, 50 WP, (Benlate) (fungicide)	pound	14.17	40.76	578
	Carbaryl, 80WP (Sevin) (insecticide)	pound	6.09	101.89	621
	Chlorothalonil 10M cu. ft.(Termil) (fung.)	canister	1.76	20.37	36
	Other (i.e. Kelthane, Captan, Di-syston, Orthene, etc.)*****				1,158
Subtotal					20,875
Machinery and Equipment					
	Tractor, 100 HP	hour	17.00	29.04	494
	Tractor, 60 HP	hour	11.68	125.56	1,467
	Tractor, 34 HP	hour	4.99	156.04	779
	Articulated Loader/2,000lbs	hour	6.67	126.42	843
	Articulated Loader/3,000lbs	hour	14.81	126.42	1,872
	Forks	hour	0.01	252.83	3
	Plow, 3-14"	hour	6.57	7.74	51
	Disk, 8' wide	hour	4.23	15.67	66
	Harrow, 10' wide	hour	8.45	1.16	10
	Cultimulcher, 10' wide	hour	24.70	2.28	56
	Spray rig with 10' boom	hour	2.77	11.28	31
	Transplanter, 3 row	hour	26.75	7.99	214
	Permanent irrigation\ well & pump 100HP	hour	7.60	61.50	467
	Inground irrigation - bed area	hour	3.13	32.00	100
	Above ground irrigation - bed area	hour	1.83	32.00	59
	Inground irrigation - storage & holding	hour	5.65	12.00	68
	Above ground irrigation - storage & hold.	hour	11.05	12.00	133
	Traveler gun	hour	12.06	17.50	211

Table 2 Cont.

Item	Description	Unit	Cost per Unit**	Quantity	Total Variable Cost
	Portable PTO pump, 40 HP	hour		(no costs budgeted)	
	Airblast sprayer	hour	1.01	78.75	80
	Fertilizer injector	hour	12.39	1.50	19
	Transplanter, 2 row	hour	12.00	13.31	160
	Undercutter, bed	hour	1.16	7.68	9
	Sidedresser, 2 row	hour	0.63	15.75	10
	Cultivator, 2 row	hour	0.95	34.66	33
	Wagon, 4 wheel	hour	0.48	70.76	34
	Cultivator, 3 row	hour	13.93	3.04	42
	Truck, 1/2 ton pickup	hour	8.42	533.31	4,490
	Flatbed truck, 24' bed	hour	14.87	157.14	2,337
Subtotal					14,138
Labor					
	Labor hours	hour	6.93 ****	7,165.73	49,658
	Related labor hours, 20%	hour	6.93	1,433.15	9,932
Subtotal					59,590
Interest Charge on Operating Capital	Computed at 12% on an annual basis for 6 months	percent	6.0 (0.06)	97,417.00	5,845
Total Variable Costs					103,262
Variable Cost per 3-4' Tall Salable Plant	Units available for sale in a given year	each		27,162.00	3.80

*Total Nursery - 200 acres, 175 acres of growing space, 25 acres production facilities, holding & field bed area, roads, etc. Deciduous Shrubs - 40 acres, 35 acres of growing space, 5 acres production facilities, holding & field bed area, roads, etc., 27,162, 18-24 inch salable plants per year.

**Quantity discounts were applied to chemicals and other items.

***51,927 plants would be stuck in the propagation house where about 23% would be lost leaving 39,944 for transplanting into liner beds. About 20% of the plants in liner beds would be lost leaving 31,955 for transplanting into the field.

****Average basic wage before withholding taxes and fringes $5.25, taxes and fringes add 32% or $1.68 for a total of $6.93.

*****To achieve better pest and disease control, alternative chemical useage is advisable. Alternative chemical costs were estimated at 50% of the cost of Malathion, Benomyl, and Carbaryl.

Table 3.--Summary of Annual Fixed, Variable, and Total Costs (Dollars) of Producing Deciduous Shrubs (Viburnum) in the Field in Ohio, 1985.

Item	50 Acre Field Nursery*			200 Acre Field Nursery**		
	Cost	Cost per Salable Plant	Percent of Total Cost	Cost	Cost per Salable Plant	Percent of Total Cost
Fixed Cost Items						
Land and Improvements	7,061	1.14	9	21,716	.80	11
Buildings	4,740	.76	6	6,811	.25	4
Machinery and Equipment	13,173	2.12	18	25,495	.94	13
General Overhead	20,592	3.32	28	32,685	1.20	17
Interest on General Overhead, Insurance, and Taxes	1,336	.22	2	2,198	.08	1
Subtotal	46,902	7.56	63	88,905	3.27	46
Variable Cost Items						
Propagation	1,634	.26	3	2,814	.10	1
Materials	4,745	.76	6	20,875	.77	11
Machinery and Equipment	5,965	.96	8	14,138	.52	8
Labor	13,735	2.21	18	59,590	2.19	31
Interest on Operating Capital	1,565	.25	2	5,845	.22	3
Subtotal	27,644	4.44	37	103,262	3.80	54
Total Annual Costs	74,546	12.00	100	192,167	7.07	100

*Total Nursery - 50 acres, 40 acres of growing space, 10 acres production facilities, holding & field bed area, roads, etc.
Deciduous Shrubs - 10 acres, 8 acres of growing space, 2 acres of production facilities, holding & field bed area, roads, etc.
**Total Nursery - 200 acres, 175 acres of growing space, 25 acres production facilities, holding & field bed area, roads, etc.
Deciduous Shrubs - 40 acres, 35 acres of growing space, 5 acres production facilities, holding & field bed area, roads, etc.